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ECOLOGY OF THE JAPANESE DORMOUSE, *GLIRULUS JAPONICUS*

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Different places of hibernation of *Glirulus japonicus* were monitored. The home range of a male was larger than that of a female, and they overlapped. The adult female remains in her home range for several years and has litters, while the young female moves from the mother's home range. The Japanese dormouse eats bark, pollen and insects. It sometimes saved food as food-caché in autumn.

Key words: ecology, *Glirulus japonicus*, Japan

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Promatrana su različita mjesta hibernacije *Glirulus japonicus* u Japanu. Životni prostor mužjaka je veći nego ženkin i oni se preklapaju. Odrasle ženke ostaju u granicama svog životnog prostora nekoliko godina i imaju mlade, dok mlade ženke napuštaju taj prostor čim odrastu. Japanski puh jede koru drveće, pelud i kukce. Ponekad u jesen sprema zalihe hrane.

Ključne riječi: ekologija, *Glirulus japonicus*, Japan

INTRODUCTION

The Japanese dormouse, *Glirulus japonicus*, is a species endemic to Japan and is designated as a natural monument of Japan. Several studies have been made on the Japanese dormouse: about hibernation (SHIMOIZUMI, 1939, 1940, 1943; OTSU & KIMURA, 1993), about food (SHIMOIZUMI, 1933; MINATO, 1989), and about ecology

(MORI & MORIE, 1978; MINATO, 1984, 1992; NAKAJIMA, 1993). However, information about the life history of this species is very poor.

Our study includes the following four steps. 1) General biological study of the Japanese dormouse: ecology, ethology, genetics, and physiology of hibernation. 2) Establishment of a method for conservation. 3) Establishment of measures for forest conservation through protection of the Japanese dormouse. 4) Utilization of the results obtained as material for environmental education.

In this paper, we describe our ecological findings on the Japanese dormouse: home range, arboreal behavior, diet, nesting, food storage, and place of hibernation.

METHODS

Our fieldwork was carried out from 1988 through 1996. The study site is flat land with deciduous forests, located in Ooizumi village (35° 56' N, 138° 25' E), Yamanashi Prefecture, at an altitude of 1500m, on the southeastern slopes of Mt Akadake. The dominant plant species in this field are *Pinus densiflora* and *Betula platyphylla* var. *japonica*. The tree layer consists mainly of *Pinus densiflora* and *Larix leptolepis*. In the sub-tree layer, *Clethra barbinervis* is dominant, with *Prunus maximowiczii* and *Sorbus alnifolia*. There are *Enkianthus campanulatus*, *Rhododendron kaempferi* and *Rhododendron japonicum* in the shrub layer. In the herbaceous layer, *Sasa niponica* is abundant. Lianas, including *Vitis coignetiae*, *Rhus orientalis*, and *Celastrus orbiculatus*, were sometimes wound around other species.

Many stakes were driven at intervals of twenty meters within 9 ha of the study site. 315 nest boxes were placed at least 4 m and on average 20 m apart from each other at a height of about 1.5 m on trees occurring near the stakes. A map of the study site was made. Positions of dormice sighted, nestboxes, and trees for feeding were plotted precisely on the map. Home ranges, resting places in the daytime and hibernation places were monitored by using a radiotelemetry system. An entire transmitter weighed about 0.7–2.9 g. Arboreal behavior and home ranges were observed by using luminous material applied on the dorsum of the animals. In some cases, both transmitter and luminous material were applied to the same adult individuals. The area of the home range was calculated by the Minimum Convex Polygon method.

RESULTS

Home ranges and movements

A male had a home range larger than a female. In 1991, a male had a home range larger than and overlapping with those of two mothers. The area of the home range of this adult male was about 20,000 square meters and those of the two moth-

ers were 4400 and 9200 square meters. The home ranges of the mothers did not overlap with each other.

In the 1992 survey, the areas of the home ranges of three females were 796–10532 square meters. One of these home ranges was of an adult female with her young. The home ranges of the other females, which were sub-adult, did not overlap with that of the adult female. The sub-adult females had a smaller home range than that of the adult female.

An adult female stayed for several years in the same home range and had young there every year.

A young female was observed to fall into a daily torpor after she became independent of her mother. This may economize the energy of the young animal, who is unskilled in finding food in the forest.

Not many data of dispersal movement were obtained in our field. In one example, a young female moved about 1.5 km from her birth place, and had three young there.

This suggests that the adult female stays in her home range for several years and has her young there, and the young female moves from the mother's home range.

Arboreal behavior

The Japanese dormouse showed the following characteristics in arboreal behavior.

- 1) It moved very quickly.
- 2) It often walked on the underside on branches. If it moved on the top of branches, there were many obstacles of thin branches and leaves, while walking underneath was easier.
- 3) It often jumped about 30 cm from trunk to trunk.
- 4) It often searched for food on the underside of thin branches and leaves.
- 5) It moved along the same arboreal course twice to three times during a night. On the way, it drank water from a tree hole filled with water.
- 6) Males sometimes emit aggressive calls on the border of their home range or near feeding trees.
- 7) It moved even in the rain.

Food

Arboreal behavior of the Japanese dormouse showed a pattern characterised by staying on certain trees for feeding and moving very quickly between these trees. It fed on particular tree species during our observation: *Malus sieboldii*, *Sorbus japonica*, *Picea jezoensis*, *Clethra barbinervis* and *Larix leptolepis*.

1) Bark

The Japanese dormouse fed on the bark of dead branches of *Malus sieboldii* and never of live branches. It fed on it through the active season, and the bark of this tree is an important food for the dormouse.

2) Seed

A dormouse fed on the immature seeds of *P. jezoensis*. The dormouse hung on a branch with its hind-legs and ate the seeds while turning the nut.

3) Pollen

A dormouse fed on pollen of *L. leptolepis*. The dormouse visited the same tree of *L. leptolepis* repeatedly during night.

4) Insect

When the Japanese dormouse stayed on trees of *S. japonica*, it walked and ran as if it were skating on the underside of thin branches, seeking food. This behavior was similar to the searching behavior of the Japanese dormouse being reared, looking for caterpillars on trees. When one animal was walking on a *S. japonica*, a caterpillar dropped onto the head of the observer. A dormouse ate a caterpillar and black insects. A mother repeatedly visited the same *S. japonica* trees over two nights, going there twice a night looking for food. A dormouse searched for insects hidden inside the bark of *C. barbinervis* and ate them. A dormouse accidentally met a daddy longlegs on the trunk, caught it and ate it.

Food storage

The Japanese dormouse often stored food as food cache in the nest-box autumn. Stored food consisted of the nuts of *C. orbiculatus* and *M. sieboldii*. It fed on stored food before and after hibernation.

Breeding nests, daytime resting place

In 1992, during the breeding season a mother constructed four breeding nests which were spaced 38.0–65.0 meters apart from each other. Two spherical nests were found in two nest boxes, and two nests were observed in bushes of *Rhododendron japonicum*. In the latter case, the nests were at a height of 1.1 and 1.7 meters from the ground. She built the nests in the densely growing branches of *Rhododendron japonicum*. The size of a nest was 11.0 x 6.0 cm with an entrance of 3.0 x 2.5 cm. The inner layer was made of woven bark. The outer layer was covered with bryophytes. The main nest materials were barks and bryophytes. The barks of *B. platyphylla* var. *japonica*, *C. barbinervis* and *L. leptolepis* were utilized. Stalks of *S. nipponica* and leaves of *L. leptolepis* were also found in small quantities. When we translocated a nest attached to the supporting branches, the mother closed the entrance of the nest with bryophytes and never came out of the nest. In contrast, when men touched the nest, *Apodemus argenteus* immediately escaped from it.

Except for breeding females, the Japanese dormouse had no fixed places for day-time resting, and took their rest in different places from day to day within its own home range, as follows:

- 1) in decayed branches,
- 2) in decayed trunks,
- 3) in tree holes,
- 4) under fallen leaves which they store between several trunks,
- 5) in a depression found in decayed branches,
- 6) in bushes of *Rhododendron japonicum*,
- 7) in nest boxes.

Place of hibernation

Nine places of hibernation were monitored using telemetry. The Japanese dormouse chose the following places for hibernation,

- 1) under the ground (depth: 5.0–32.0 cm).
- 2) under fallen leaves (depth: 4.0 cm).
- 3) in decayed branches or trunks.
- 4) in tree holes.

5) in the nests which *Apodemus argenteus* constructed in tree holes and in the nest boxes. When it hibernated under the ground or under fallen leaves, it remained near the surface.

DISCUSSION

The area of the home range of a male was larger than that of two females and overlapped with their home ranges. A male mated with several females during the breeding season (MINATO, unpublished). The male may mount several females living within his home range as well as other females living around the boundary of his home range. The home ranges of the mothers did not overlap with each other, so the boundary of their home ranges would be definite.

The adult female stays in her home range for several years and has her young, and the young female moves from the mother's home range. The home range in *Muscardinus avellanarius* is typically about 3000 square meters (BRIGHT & MORRIS, 1992), which is smaller than that of the Japanese dormouse.

The Japanese dormouse fed on particular tree species. It is difficult for the Japanese dormouse to break the acorns found abundantly in the forest. It seems that there is not food in abundance for the Japanese dormouse throughout the year in the forest, and therefore its population can not increase like that of mice in Japan.

The Japanese dormouse used decayed trunks and branches of *B. platyphylla* var. *japonica* as a resting place, probably because these materials were easier to work. Decayed trees and branches are useful for the dormouse in the forest.

The Japanese dormouse could rest anywhere within its home range in the forest, and did not make nests at fixed places. The Japanese dormouse may thus be a wanderer in the forest.

When the Japanese dormouse hibernated under the ground and under fallen leaves, it remained near the surface. This suggests that it can hibernate at places in which it gets wet in the rain. It can move around on a rainy night as well as on a fine night. These facts indicate that the Japanese dormouse has a water-proof fur.

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SAŽETAK

Ekologija japanskog puha, *Glirulus japonicus*

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Japanski puh, *Glirulus japonicus*, endemična je vrsta za Japan. Istraživanje je obuhvatilo ekologiju, etologiju, genetiku i fiziologiju hibernacije ove vrste. Željeli smo utvrditi mjere za zaštitu vrste, kao i šuma u kojima živi. Rezultati ove studije namijenjeni su edukativnoj svrsi. Istraživanje je obavljeno od 1988. do 1996. godine. Utvrđeno je da je životni prostor mužjaka veći nego ženkin. Odrasle ženke ostaju u granicama svog životnog prostora nekoliko godina, dok nove mlade ženke taj prostor napuštaju čim odrastu. Japanski puh jede koru drveća, pelud i kukce. Biljke kojima se hrani su sljedeće: *Malus sieboldii*, *Sorbus japonica*, *Picea jezoensis*, *Clethra barbinervis* i *Larix leptolepis*. Primjećeno je da stvara zalihe hrane u jesen, i to plodove *Celastrus orbiculatus* i *Malus sieboldii*. Tijekom perioda aktivnosti puhovi su boravili na starim deblima i granama biljke *Betula platyphyllos* var. *japonica*. Hibernirali su ispod površine i ispod lišća, uvijek blizu površine tla. Nisu se zadržavali na određenim mjestima u okviru svog životnog prostora. Za određivanje veličine životnog prostora, te mjesta odmaranja i hiberniranja korištena je radiotelemetrija, a za promatranje ponašanja u šumi na leđa životinja nanošena je svjetlucava tvar pomoću koje ih se lakše moglo pratiti.